

## STUDIES ON PHYSICO-CHEMICAL ANALYSIS OF SORGHUM VARIETIES

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### ABSTRACT

*The present study was conducted in the laboratory of the Department of Food Trade and Business Management, College of Food Technology, Vasant Rao Naik Marathwada Krishi Vidyapeeth, Parbhani, to determine physico-chemical properties of sorghum varieties. The result revealed that moisture, protein, fat, ash and total carbohydrate content in the Sorghum varieties were found in the range of 12 to 13.9%, 9.8 to 15.08%, 3.8 to 4.71%, 1.89 to 2.06% and 65.8 to 70.52% respectively.*

**KEYWORDS:** Moisture, Protein, Fat, Ash and Total carbohydrate

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### INTRODUCTION

Sorghum [*Sorghum bicolor* (L.) Moench] popularly called as *jowar*, is the “king of millets” and is the fifth in importance among the world’s cereals after wheat, rice, maize and barley (Anglani, 1998; Awika and Rooney, 2004). Great advantage of sorghum is that it can become dormant under adverse conditions and can resume growth after relatively severe drought. The major sorghum production areas today include great plains of North America, sub-Saharan Africa, north eastern China and the Deccan plateau of central India, Argentina, Nigeria, Egypt and Mexico (Awika and Rooney, 2004). Sorghum is mostly used as food (55%), in the form of flat breads and porridges (thick or thin) in Asia and Africa, and as feed (33%) in the Americas (Anonymous, 2012). Sorghum provides a good basis for gluten-free products and recommended as safe for celiac patients. Therefore, the future promise of sorghum in the developed world is for wheat substitution for people with celiac disease or allergies to gluten (Bogue and Sorenson, 2008). Globally sorghum grain production in 2011 was 59.2 million tons and planted area was 38.7 million hectares with an average grain yield of 1527.4 kg/ha. In India, sorghum grain production during 2011-2012 was 6 million tons and planted area was 6.3 million hectares with an average grain yield of 0.95 tons per hectare (Anonymous, 2013).

### MATERIALS AND METHODS

Sorghum [*Sorghum bicolor* (L.) Moench] varieties like *Parbhani Moti*, *Parbhani Jyoti*, *Akola Kranti*, *Phule Revati* and *Phule Vasuda* were procured from Sorghum Research Station Parbhani, Maharashtra. Chemicals (analytical grade) and glass wares required during experiments were used from laboratory. Equipments required in the present investigation were available in College of Food Technology, Vasant Rao Naik Marathwada Krishi Vidyapeeth, Parbhani.

## Physical Characteristics of Sorghum Varieties

### Geometric Mean Diameter

The seeds to be measured were taken randomly as 100 samples. The dimensions of sorghum seeds were measured as length and thickness and width. Following equation was used for determining the Geometric Mean Diameter of seeds (Gürsoy and Güzel 2010).

$$d_g = (abc)^{1/3}$$

Where

$d_g$ : geometric mean diameter in mm;

**a**: length of seed in mm;

**b**: width of seed in mm;

**c**: thickness of seed in mm.

### 1000 kernel Weight of Sorghum Grains ( $w_{1000}$ )

Neat, clean and sorted 1000 sorghum grains weight is measured by electronic balance.

### Bulk Density

Bulk density (BD) of seeds was measured by standard method given by (AOAC, 1990).

### True Density

The true density ( $\rho_t$ ), defined as the ratio of the mass of the sample of seeds to the solid volume occupied by the sample, was determined using an electronic balance reading to 0.0001 g and a pycnometer (50±0.1 ml) (liquid displacement method). (Xylene (density: 0.862±0.001 g cm<sup>-3</sup>) was used instead of water because it was absorbed by seeds to a lesser extent. Due to the short duration of the experiment, xylene absorption was found to be negligible and therefore seeds were not coated for its absorption prevention.

### Porosity

The porosity ( $\epsilon$ ) of the bulk seed is the fraction of the space in the bulk grain that is not occupied by the grain. The percent porosity was calculated on the following relationship.

$$\epsilon (\%) = \frac{\text{True density } (\rho_t) - \text{Bulk density } (\rho_b)}{\text{True density } (\rho_t)} \times 100$$

## Chemical Characteristics of Sorghum Varieties

Sorghum varieties were analyzed for moisture content, ash, fat, protein and total carbohydrate. All the determinations were done and the results were expressed as the average value.

### Moisture

Moisture content was estimated adopting AOAC (1990) method. The following was used to measure moisture content.

$$\text{Moisture content (\%)} = \frac{\text{Loss in weight}}{\text{Weight of sample}} \times 100$$

### Ash Content

AOAC (1990) method using muffle furnace was used to determined ash content of the samples. The per cent ash was calculated using following formula

$$\text{Ash content (\%)} = \frac{AW}{IW} \times 100$$

Where

AW = Weight of ash.

IW = Initial weight – drymatter

### Fat Content

AOAC (1990) method using soxhlet apparatus was used to determined crude fat content of the samples. The percent of crude fat was expressed as follows

$$\text{crude fat (\%)} = \frac{\text{Weight of dried ether soluble material}}{\text{Weight of sample}} \times 100$$

### Protein

Protein content was determined using AOAC (1990) method. Percentage of nitrogen and protein calculated by the following equation

$$\text{Nitrogen (\%)} = \frac{T_s - T_b \times \text{Normality of acid} \times \text{meq. of N}_2}{\text{Weight of sample (g)}}$$

Where

T<sub>s</sub> = Titre volume of the sample (ml)

T<sub>b</sub> = Titre volume of Blank (ml)

Meq. of N<sub>2</sub> = 0.014 and % Protein = Nitrogen × 5.7

### Total Carbohydrate

Total carbohydrate content of the samples were determine as totalcarbohydrate by difference, that is by subtracting the measured protein, fat, ash and moisture from 100 (Pearson, 1976).

## RESULTS AND DISCUSSIONS

### Visual Physical Parameters of Sorghum Cultivars

The samples were compared with Munsell colour chart and colour was represented in the values of hue, value and chroma. Colour of *Parbhani Moti*, *Parbhani Jyoti*, *Phule Vasuda*, *Akola Kranti* and *Phule Revati* were pearly white(5Y 8/2), creamy white(5Y 7/2), dull white(10YR 8/2), pale yellow(10YR 7/2) and pearly white(10YR 6/2) respectively. In sorghum, phenolic compounds, particularly anthocyanins and condensed tannins are major contributors of colour of the grains (Awika and Rooney 2004). Results were nearer to the results physico-chemical properties of sorghum genotypes reported by Jambamma *et al.* (2011).

**Table 1: Visual Physical Properties of Sorghum**

Sr. No.	Cultivars	Visual parameters of grain		
		Colour	Muncell Notation for Colour	Shape
1	<i>Parbhani Moti</i>	Pearly white	5Y 8/2	Very bold
2	<i>Parbhani Jyoti</i>	Creamy white	5Y 7/2	Bold
3	<i>Phule Vasuda</i>	Dull white	10YR 8/2	Round
4	<i>Akola Kranti</i>	Pale yellow	10YR 7/2	Bold
5	<i>Phule Revati</i>	Pearly white	10YR 6/2	Round

**Physical Properties of Sorghum Cultivars**

The highest thousand kernel weight (34.30g) and thousand kernel volume (28.5 ml) was observed for *Parbhani Moti*. Whereas the lowest thousand kernel weight (33.1g) was observed in *Parbhani Jyoti*. This variation may be due to genotypic differences. The weight of thousand kernels is influenced by meteorological factors, methods of farming and genotypic differences (Liman *et al.*, 2012).

True density is an index of floury and corneous endosperm ratio inside the kernels. The true density of *Akola Kranti* (as 1.8 g/ml) was found to be highest while *Parbhani Moti* reported lowest one (1.2 g/ml).

*Akola Kranti* had recorded highest bulk density (0.9 g/ml) while *Parbhani Moti* reported lowest one (0.6 g/ml). No significant difference in the value of angle of repose was observed among the cultivars. The obtained values for physical properties recorded in the present study are in line with findings of Vannalli *et al.* (2008).

**Table 2: Physical Properties of Sorghum**

Grains	Physical Properties of Grains					
	Thousand Kernels Weight (g)	Kernel Size G.M.D (mm)	Thousand Kernel Volume (ml)	True Density (g/ml)	Bulk Density (g/ml)	Angle of Repose (Degrees)
<i>Parbhani Moti</i>	34.3	3.81	28.5	1.2	0.6	32°42'
<i>Parbhani Jyoti</i>	33.1	4.08	23	1.4	0.7	32°11'
<i>Phule Vasuda</i>	34.1	3.91	26	1.3	0.65	30°15'
<i>Akola Kranti</i>	34.2	4.02	18.5	1.8	0.9	31°12'
<i>Phule Revati</i>	34.2	3.73	24	1.3	0.65	30°12'
SE ±	0.1105	0.0270	0.129	0.0577	0.0624	-
CD at 5 %	0.3331	0.08161	0.3890	0.1739	0.1882	-

**Note:** Each value is a mean of three determinations

**Nutritional Composition of Sorghum Varieties**

Moisture content was range from 12 to 13.9 per cent, fat (3.8 to 4.71 per cent), protein (9.8 to 15.08 per cent), carbohydrate (65.8 to 70.52per cent) and ash content was ranged from 1.89 to 2.06 per cent.

The variation in per cent chemical composition might be due to variation in cultivars. Statistically results were found to be significant at CD at 5 per cent. Similar range of per cent chemical composition was reported by Chavan *et al.* (2009) and Jambamma *et al.* (2011).

Table 3: Nutritional Composition of Sorghum Varieties

Particulars	Moisture Per Cent	Fat Per Cent	Protein Per Cent	Carbohydrate Per Cent	Ash Per Cent
<i>Parbhani Moti</i>	12	4.04	15.08	66.77	2.06
<i>Parbhani Jyoti</i>	13.5	3.9	14.7	65.8	2
<i>Phule Vasuda</i>	13.9	4.71	9.95	69.54	1.9
<i>Akola Kranti</i>	13.03	3.8	13.9	67.33	1.94
<i>Phule Revati</i>	13.9	3.89	9.8	70.52	1.89
SE $\pm$	0.3631	0.0410	0.0472	0.0411	0.2396
CD at 5 %	1.0943	0.1236	0.1424	0.1241	0.7222

**Note:** Each value is a mean of three determinations

## CONCLUSIONS

It can be concluded from above discussion that physical characteristics of sorghum varieties were as colour of *Parbhani Moti*, *Parbhani Jyoti*, *Phule Vasuda*, *Akola Kranti* and *Phule Revati* were pearly white(5Y 8/2), creamy white(5Y 7/2), dull white(10YR 8/2), pale yellow(10YR 7/2) and pearly white(10YR 6/2) respectively. The highest thousand kernel weight (34.30g) and thousand kernel volume (28.5 ml) was observed for *Parbhani Moti*. True density is an index of floury and corneous endosperm ratio inside the kernels. The true density of *Akola Kranti* (as 1.8 g/ml) was found to be highest while *Parbhani Moti* reported lowest one (1.2 g/ml). *Akola Kranti* had recorded highest bulk density (0.9 g/ml) while *Parbhani Moti* reported lowest one (0.6 g/ml).

Chemical composition of moisture, protein, fat, ash and total carbohydrate content in the Sorghum varieties were found in the range of 12 to 13.9%, 9.8 to 15.08%, 3.8 to 4.71%, 1.89 to 2.06% and 65.8 to 70.52% respectively.

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